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ON THE PROSPECTS OF CAGE AQUACULTURE IN THE TUYABUGUZ RESERVOIR (UZBEKISTAN)

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Abstract

In recent decades, the increase in fish production in the world has occurred due to aquaculture - cultivation in artificial conditions. All this is very relevant for Uzbekistan, where there is practically no commercial fishing and fish production is carried out mainly in ponds [2].

In the latest guidance documents related to the fishing industry, the Government of Uzbekistan has set a goal to increase fish production to 700 tons [1].

In the republic, polyculture of carp species in earthen ponds has been excellently mastered. But the fishing industry of Uzbekistan can no longer produce 700 tons of fish using only this technology. In the conditions of a shortage of water and land resources in our republic, it is impossible to create new ponds and fill them with water in the required volumes. In these conditions, the Government of Uzbekistan is taking measures to stimulate the development of intensive aquaculture [1]. For this, in particular, it was legislatively approved that new territories for the creation of fish farms will be allocated only for enterprises that are going to use modern highly productive intensive technologies for fish farming. The fishing industry of the republic will have to master new intensive technologies, which at the same time will be resource-saving.

In this regard, cage aquaculture is the most promising for Uzbekistan[3,4]. But the republic has not carried out certification of water bodies for a long time, which greatly hinders the development of fisheries. Therefore, before installing cages, it is necessary to conduct preliminary studies of the annual monitoring of fishery

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water quality in water bodies (reservoirs) of the republic, in order to determine their fishery capabilities and prospects.

These are standard studies in such cases, but their relevance also lies in the fact that Uzbekistan has an extraordinary variety of climatic conditions and landscapes, which has a great impact on water bodies. For example, in shallow mountain rivers, the daytime water temperature in summer can rise to +25 °C, which makes it unsuitable for growing cold-water species. There are mountain reservoirs located in a cascade (Charvak and Khojikent), and in the upper of them the average annual water temperature is higher than in the one located below. The lack of data on the seasonal dynamics of water quality parameters often prevents the creation of a fish breeding enterprise on our lakes and reservoirs.

The Tuyabuguz reservoir is located just 30 km southeast of the city of Tashkent, the capital of the republic, and is a favorite place for recreation and fishing (Fig. 1).

In the last decade, it has been actively used for fishery purposes and places cages for growing carp and catfish. Its peculiarity is that it is located in the middle reaches of the Akhangaran River, a mountain river with very cold water, but due to its small area (20 km2), the reservoir manages to warm up during the spring-summer season. From a research point of view, the reservoir is of great interest. Cage fish farming for warm-water species has spontaneously developed in it, how much do they worsen the quality of water in the reservoir? Is it possible to install additional cages in this reservoir and get a stable increase in the biomass of farmed fish?

The purpose of the study: to monitor the fishery quality of water in the Tuyabuguz reservoir, to assess the possibilities and prospects of the reservoir from a fishery point of view.

The location of the study is the Tuyabuguz reservoir (Tashkent region, Republic of Uzbekistan) (Fig. 1)

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Research Methodology

1. Indicators of fishery water quality were studied: water temperature, the amount of oxygen dissolved in the water, the hydrogen potential of pH, dry residue, mineralization, the concentration of nitrates, phosphates, and total iron.
2. Sample analysis was carried out according to standard hydrochemical methods, as well as using portable equipment (HANNA HI 9147 thermooximeter, pHscan30, Escan conductivity meter
3. The calculation of the areas occupied by the cages was carried out as follows:
- in the Google Earth online program, a picture of the section of the reservoir on which the cages are installed was taken;
- Since each cage is a geometric figure (circle, square or rectangle), the area of each cage was calculated according to the formulas, then, knowing the scale of this image, the real dimensions were calculated. Cages-hexagons were taken as round in calculations

Fig.1 Tuyabuguz reservoir

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Table 1 Water Analysis Results

Date It's time	T of water (average) A S	O2, %	A2, mg/l	Ph	Dry residue, mg/l	Minera-Lysis, mg/l	NO3 mg/l	Fe 2 mg/l	PO4 mg/l
December 2023	9.0	128.2	10.11	8.46	0.3965	0.29	0.00	0.07	0.00
January 2024	8.5	136.2	11.12	8.67	0.3770	0.28	0.00	0.05	0.00
February 2024	9.8	111.3	8.72	7.79	0.3770	0.28	0.00	0.21	0.00
March 2024	12.1	113.7	9.22	8.36	0.4030	0.30	0.00	0.06	0.00

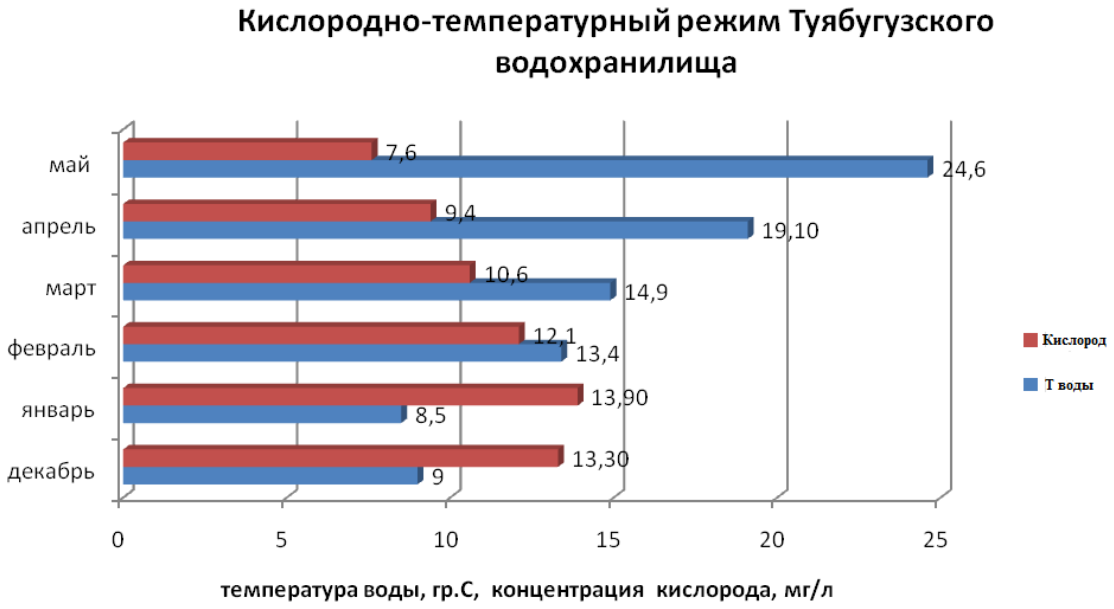

Figure 2 - Results of monitoring water temperature and oxygen content

Calculation of the area occupied by cages

In the *southwestern part of the* reservoir, there are 32 cages of round and 2 rectangular massifs, consisting of 10 small cages and 22 large cages (Fig. 3)
The scale of the image is 2.5cm : 70m.

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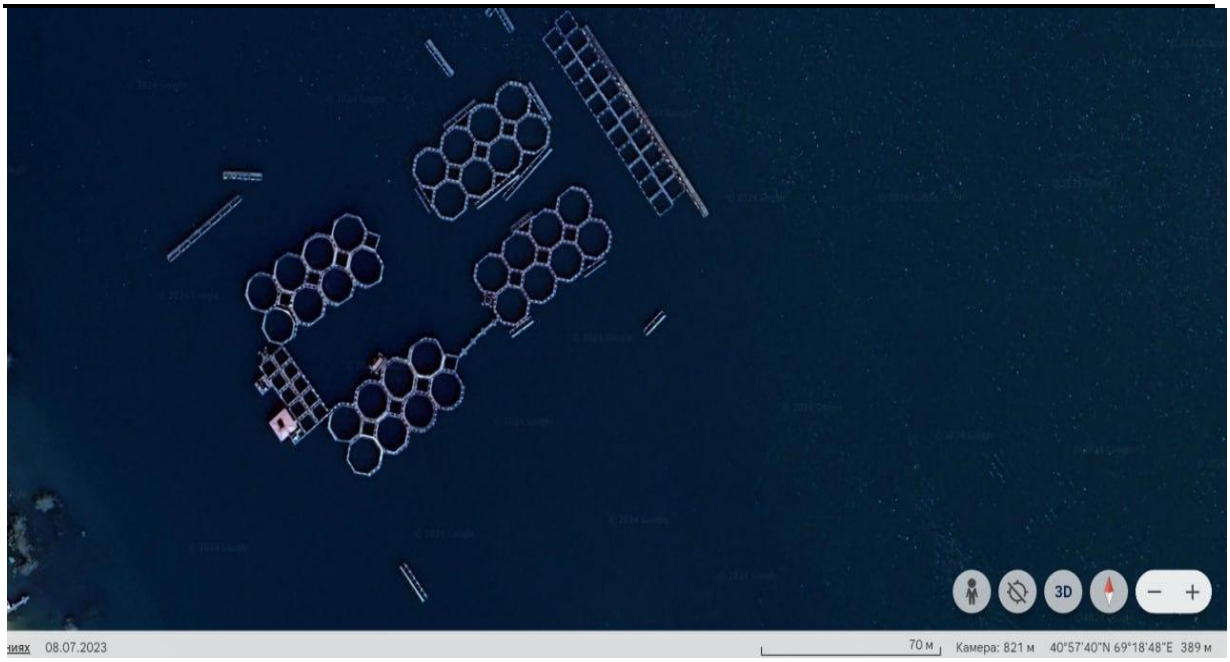

Figure 3 - South-western part of the reservoir

Based on this, the diameter of the cage is 11.2 m, and the radius is -5.6 m.
The area of the circle is calculated using the formula S = π x R2
$S_{1\ cage}$ = 3.14 x 5.62 = 98.47m2
S32 cages = 98.47m2 x 32 = 3151 m2.
The area of the rectangular cages was calculated as the area of the rectangle.
The area of small cages (total length 33.6 m, width 11.2 m) is 376.32 m2.
The area of large cages (total length 70m, width 14m) is 980m2.
Thus, the total area of cages in the southwestern part is 3151 m2 + 376.32 m2 + 980 m2 = 4 507.36 m2
In the *north-eastern part of the* reservoir there are 10 cages of round cages (Fig. 4), in this farm only carp is produced.
The scale of the image is 3cm: 90m.

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Figure 4 – North-eastern part of the reservoir

Based on this, the diameter of the cage is 27 m, the radius is 13.5 m.

$S_{1\ cage}$ = 3.14 x 13.52 = 572, 265m2

The total area of the cages is $S_{10\ cages}$ = 572, 265m2 x 10 = 5722.65m2

In the *north-eastern part there* is another large array of cages, consisting of 25 square cages (Fig. 5)

The scale of the image is 3 cm : 40 m.

Based on this, the side of the cage is 6.7 m.

$S1_{\ garden}$ = 6.7m x 6.7m = 444.4m2

The total area of the cages is $S_{25\ cages}$ = 444.4 x 25 cages = 11,110m2

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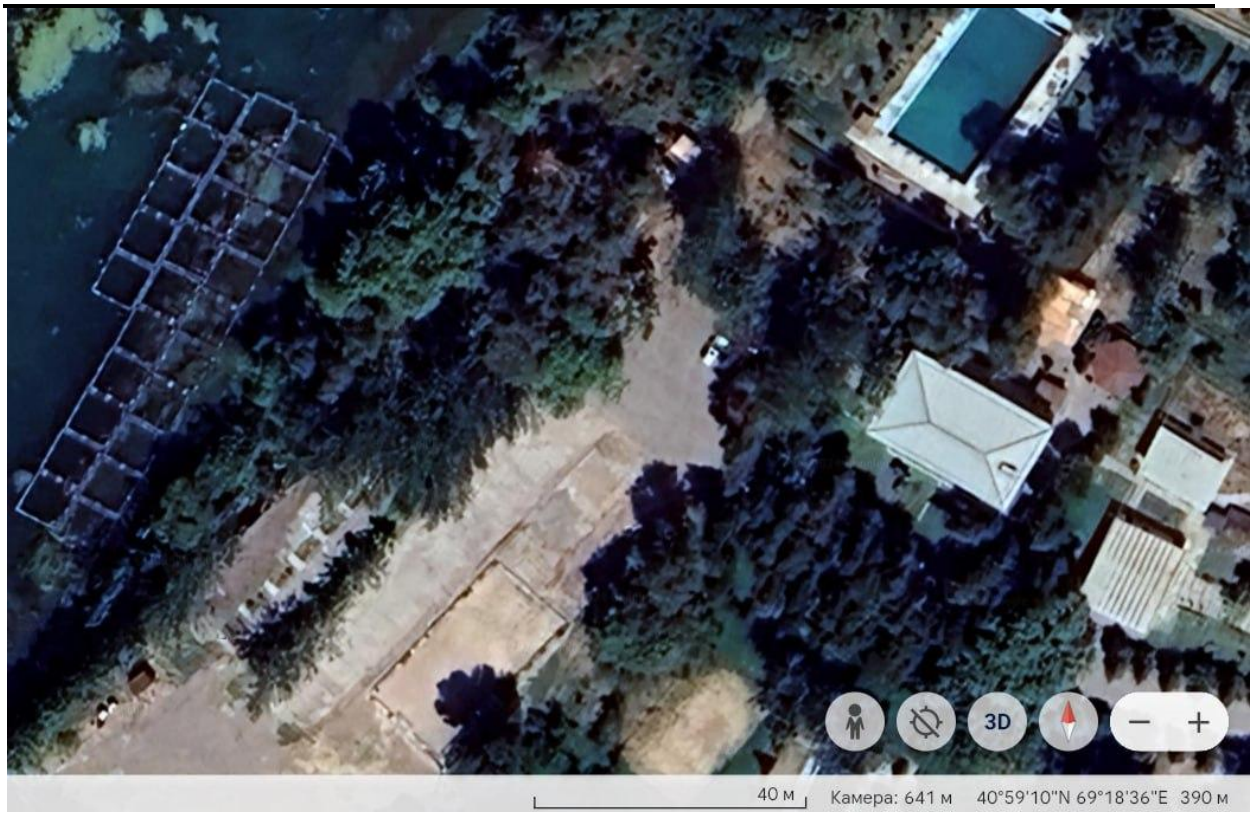

Figure 5 - Northeast 1

In the *northern part,* almost near the dam, there are 5 large octagonal cages and 4 small rectangular cages (Fig. 6) belonging to SIA "Halol Hazina". In 2023, the farm produced 30 tons of fish, of which 20 tons were African catfish and 10 tons were carp.
Image scale is 2.5cm: 50m

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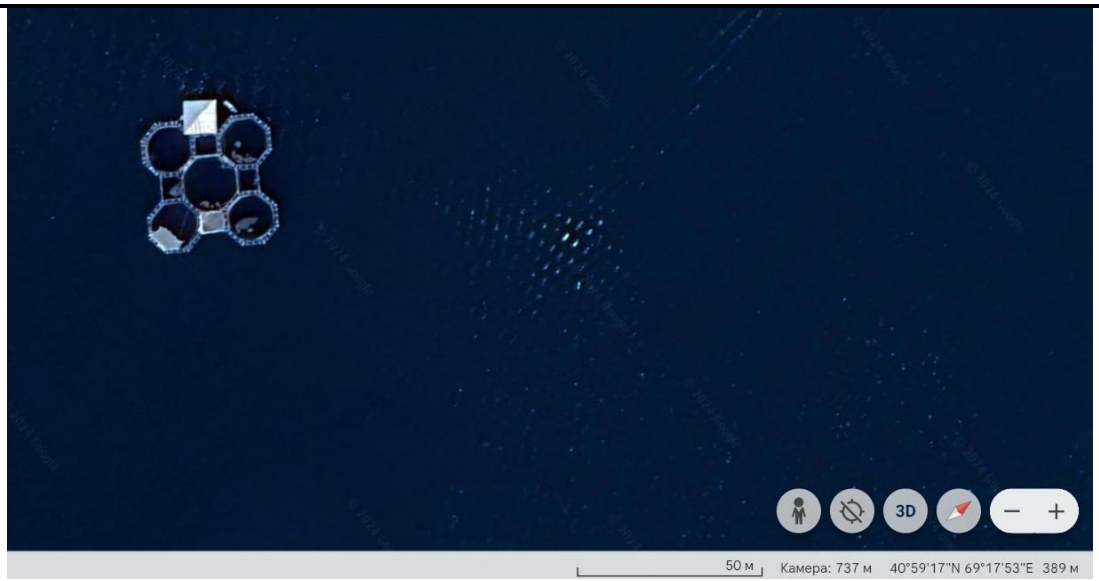

Figure 6 - Northern part

Based on this, the diameter of the round cage is 16 m, and the radius is 8 m.
$S_{1\ round\ cage} = 3.14 \times 8m2 = 200.96\ m2$
$S_{5\ round\ cages} = 200.96 \times 5 = 1004.8m2$

Длина прямоугольного садка равна 6м, ширина 5м.
$S_{1\ прямоугольного\ садка} = 6м \times 5м = 30м^2$
S4x rectangular cages = 30m2 x 4 = 120 m2

The total area of the cages installed in the northern part of the reservoir is S_{total} = 1004.8 m2 + 120 m2 = 1124.8 m2

In the *eastern part of* the reservoir there are 16 hexagonal cages and 4 small rectangular cages. The farm belongs to Golden Fish LLC.
The scale of the image is 2 cm: 30 m (fig. 7)

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Figure 7 - Eastern part of the reservoir

Based on this, if we take the area of a hexagonal cage close to the area of the circle, then the diameter of such a cage will be equal to 12 m, and the radius will be 6 m. Then S1 cage = 3.14 x 62 = 113.04m2

S16 cages = 113.04 m2 x 16 = 1808.64m2

The side of the square cage is 6 m. Then the area of one square cage is equal to

$S_{1\ cage}$ = 6 m x 6 m = 36 m2

$S_{of\ 4\ cages}$ = 36m2 x 4 = 144m2

The total area of the cages installed in the eastern part of the reservoir is equal to

S_{total} = 1808.64 m2 + 144 m2 = 1952.64 m2

In the *southeastern part of the* reservoir there are 9 hexagonal cages.

The image scale is 3 cm: 60 m (Fig. 8)

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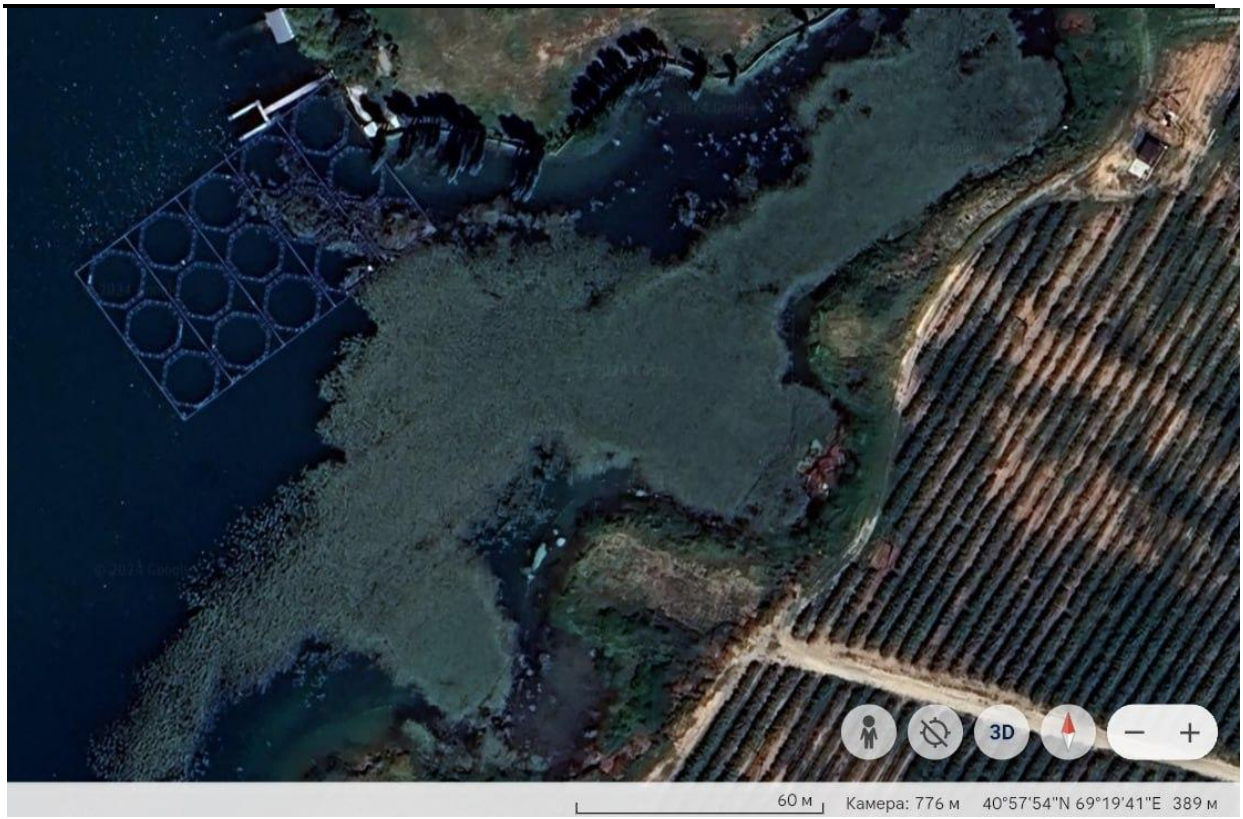

Figure 8 - South-eastern part of the reservoir

Based on this, if we take the area of a hexagonal cage close to the area of the circle, then the diameter of such a cage will be 14 m, and the radius will be 7 m.
Площадь одного садка равна S = 3.14 x 72 = 153,86м2
The area of 9 cages will be equal to 153.86 m2 x 9 = 1384.74 m2

Findings

1) African catfish and carp are grown in cages installed in the Tuyabuguz reservoir.
2) In winter, 2 cage farms successfully grew rainbow trout.
2) In total, at the time of the study (May 2024), 6 cage farms were installed in the Tuyabuguz reservoir with a total area of S = 4,507.36m2 + 5722.65m2 + 444m2 + 1124.8m2 + 1952.64m2 + 1384.74m2 =
= 15 136.19m2 = 0.0151km2

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The total area of the reservoir is 20 km2, the total area of cages is 0.076% of the area of the reservoir.

3) The quality of water at the outlet of the reservoir is within the technological norm of fish farming.

4) In cage technology, it is recommended that the total area of the installed cages does not exceed 3% of the total area of the reservoir. The total area of cages installed in the Tuyabuguz reservoir at present is 0.076% of the total area of the reservoir. Therefore, it is possible to install fish cages with an area of about 2.9% of the reservoir area, which is equal to 58 hectares.

Conclusion

In Uzbekistan, every reservoir with fresh water is of great importance, primarily domestic and irrigation. Using the reservoir for fishery purposes also means making a profit and making additional investments in the state budget. Therefore, the certification of water bodies is a necessary and very relevant research for the development of fisheries in the republic.

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